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Fuller

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(54) **ROUGH TERRAIN, LARGE WATER VOLUME, TRACK DRIVEN FIREFIGHTING VEHICLE AND ITS METHOD OF OPERATION**

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(52) **U.S. Cl.** **169/52**; 169/24; 169/46; 169/54; 239/172; 239/722; 180/6.7

(58) **Field of Search** 169/24, 46, 52, 169/54; 239/172, 722; 180/6.7

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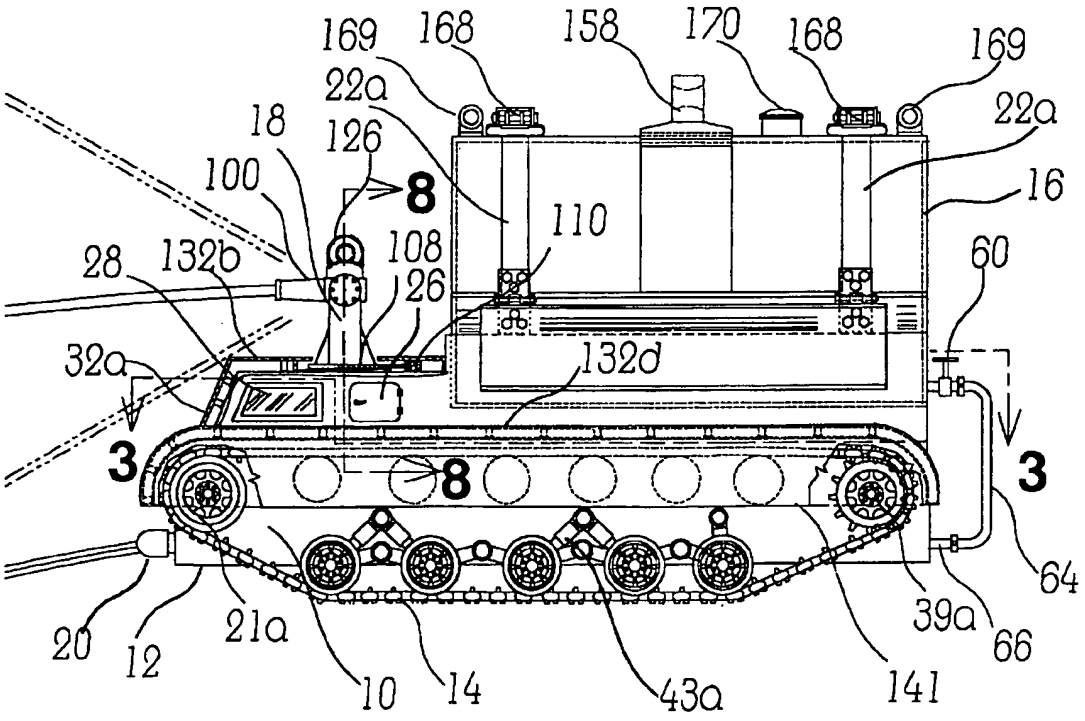
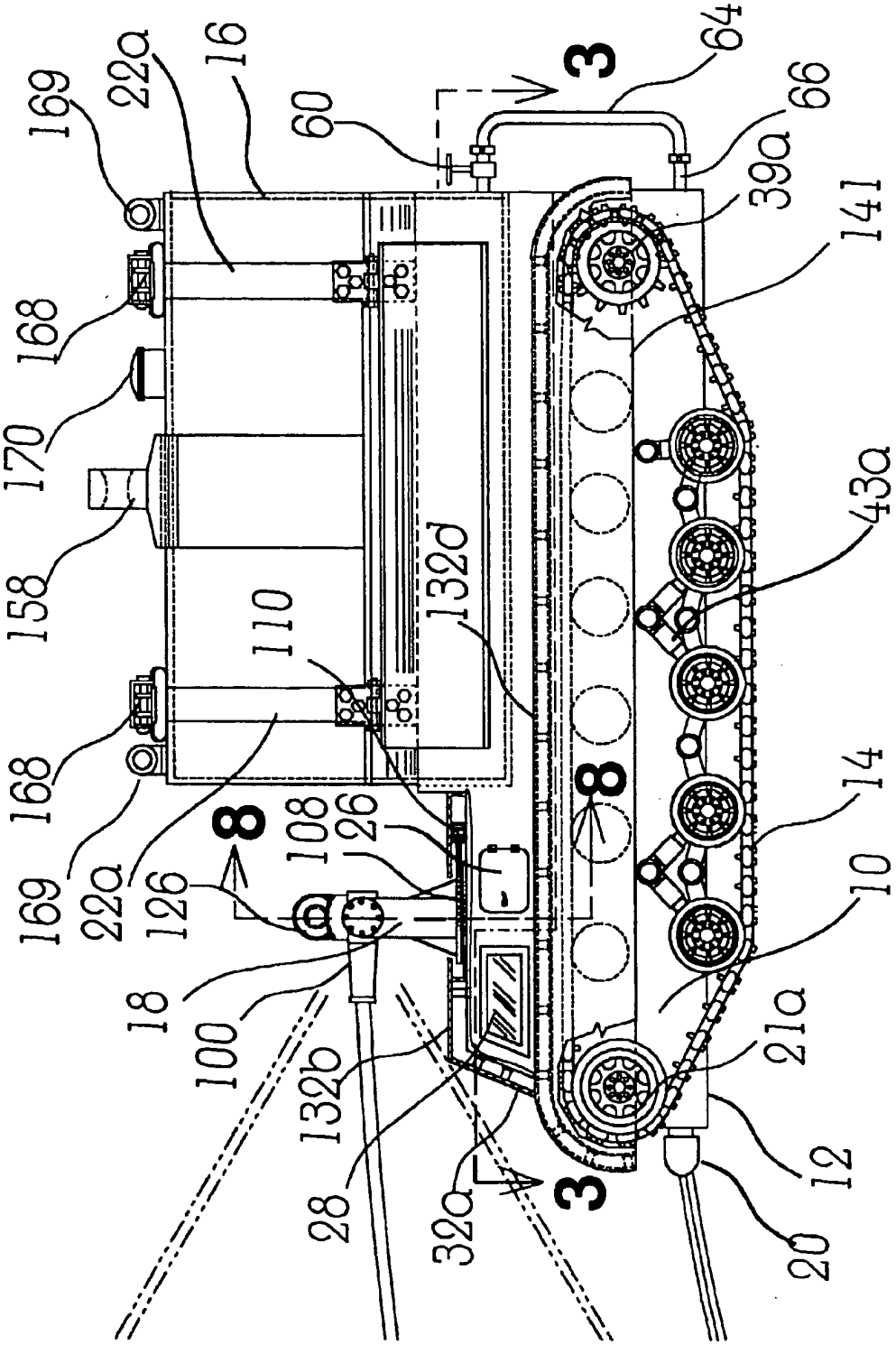
(57) **ABSTRACT**

A rough terrain, large water volume, track driven firefighting vehicle with tracked running gear for all terrain capability, having a large onboard water tank, a universal nozzle and heat shields cooled by a system of standoff sprinklers behind the shields, a forward spraying sprinkler and an operator's compartment having controls for operating the vehicle.

22 Claims, 11 Drawing Sheets

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3
64
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39a
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158
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43a
168
169
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126
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132b
28
32a
3
21a
12
20

FIG.1

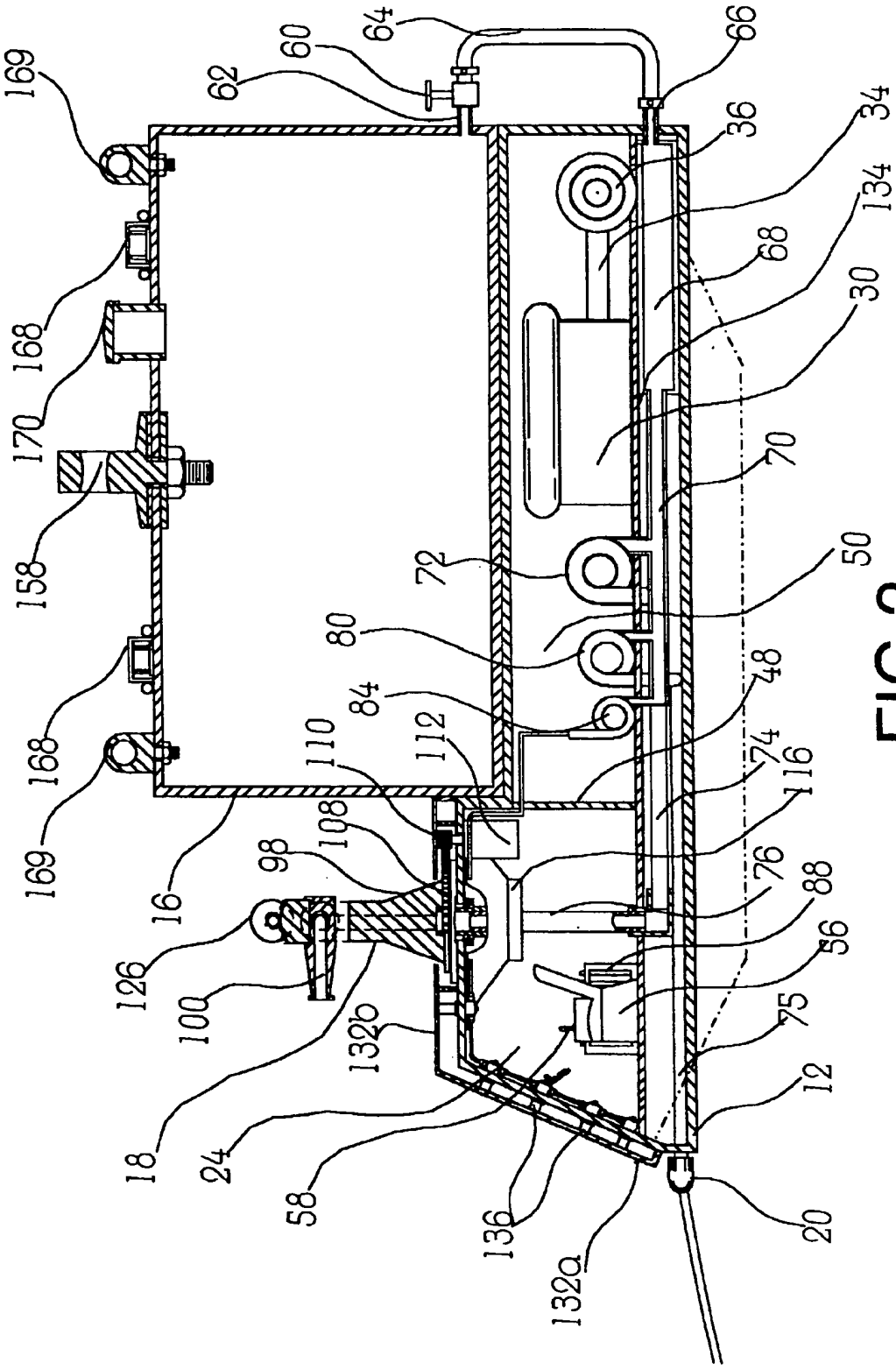
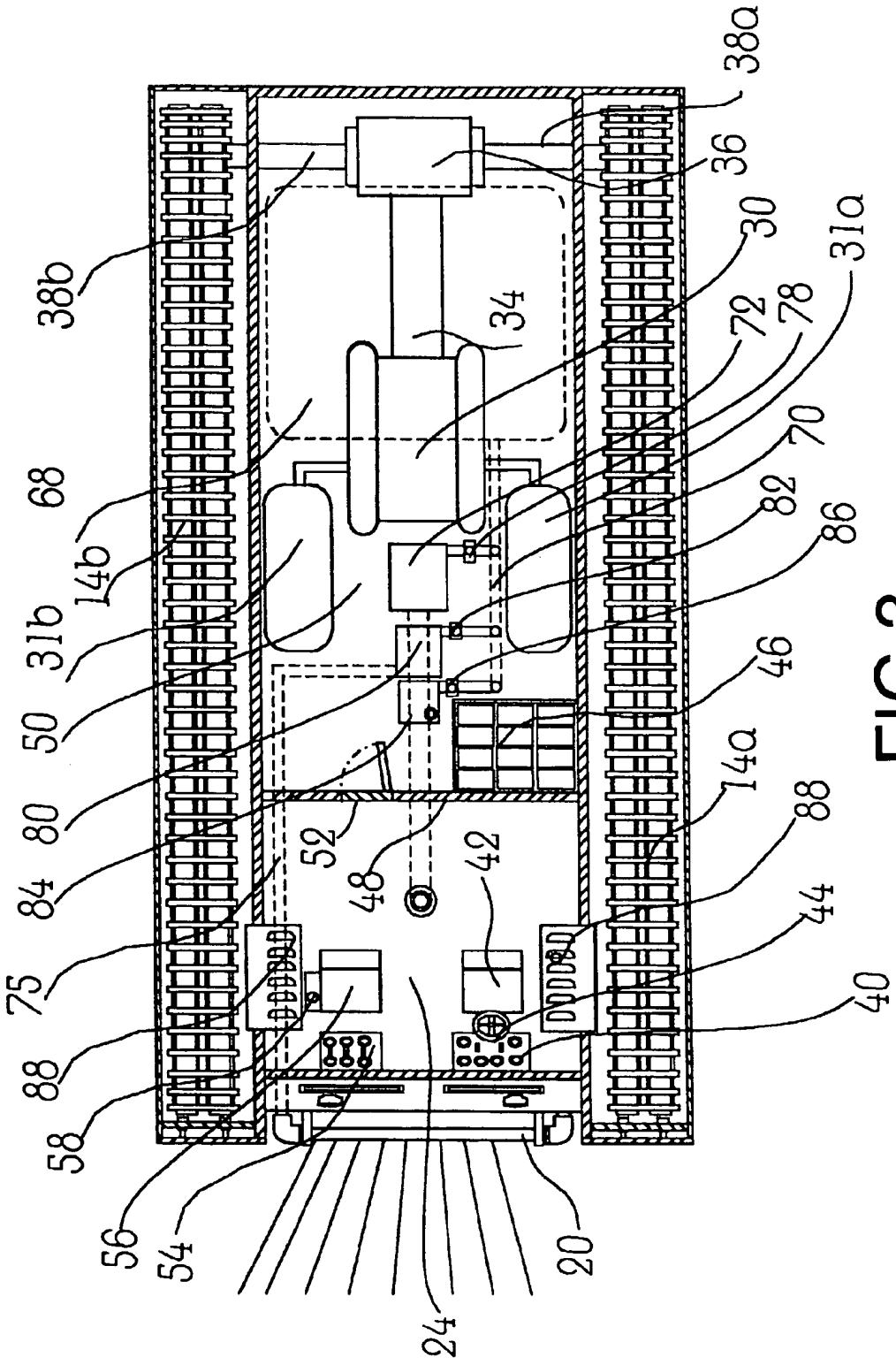

169
62
60
64
66
36
34
134
68
30
168
170
158
70
72
50
80
84
48
110
112
74
116
169
16
98
108
76
88
126
56
100
132b
75
12
18
24
58
136
132a
20

FIG.2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36
30
31a
38b
34
72
78
70
68
82
86
14b
31b
46
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48
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84
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75
40
88
58
56
54
20
24

FIG.3

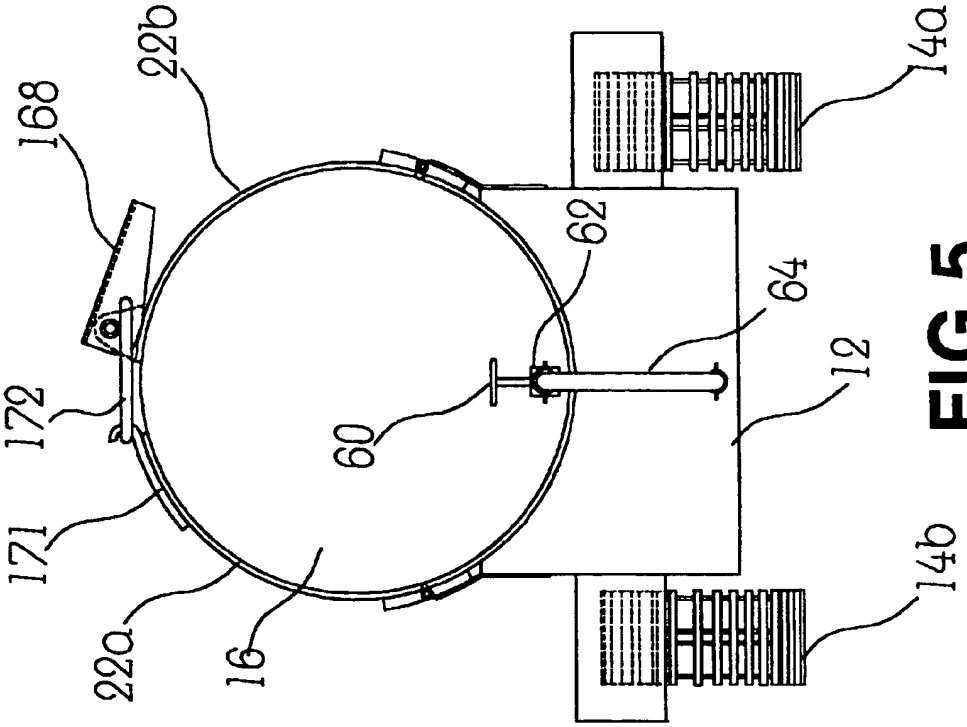

22b
168
140
62
64
12
60
172
171
22a
16
14b

FIG.5

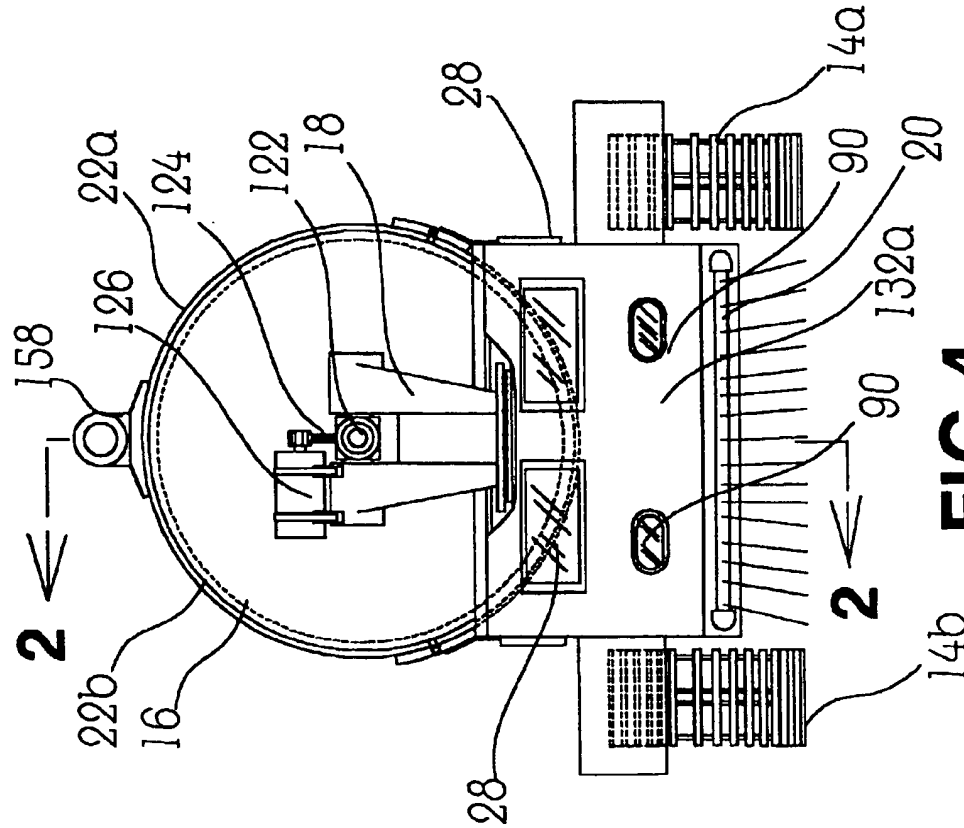

140
28
22a
124
122
18
90
20
126
132a
158
90
2
2
22b
16
28
14b

FIG.4

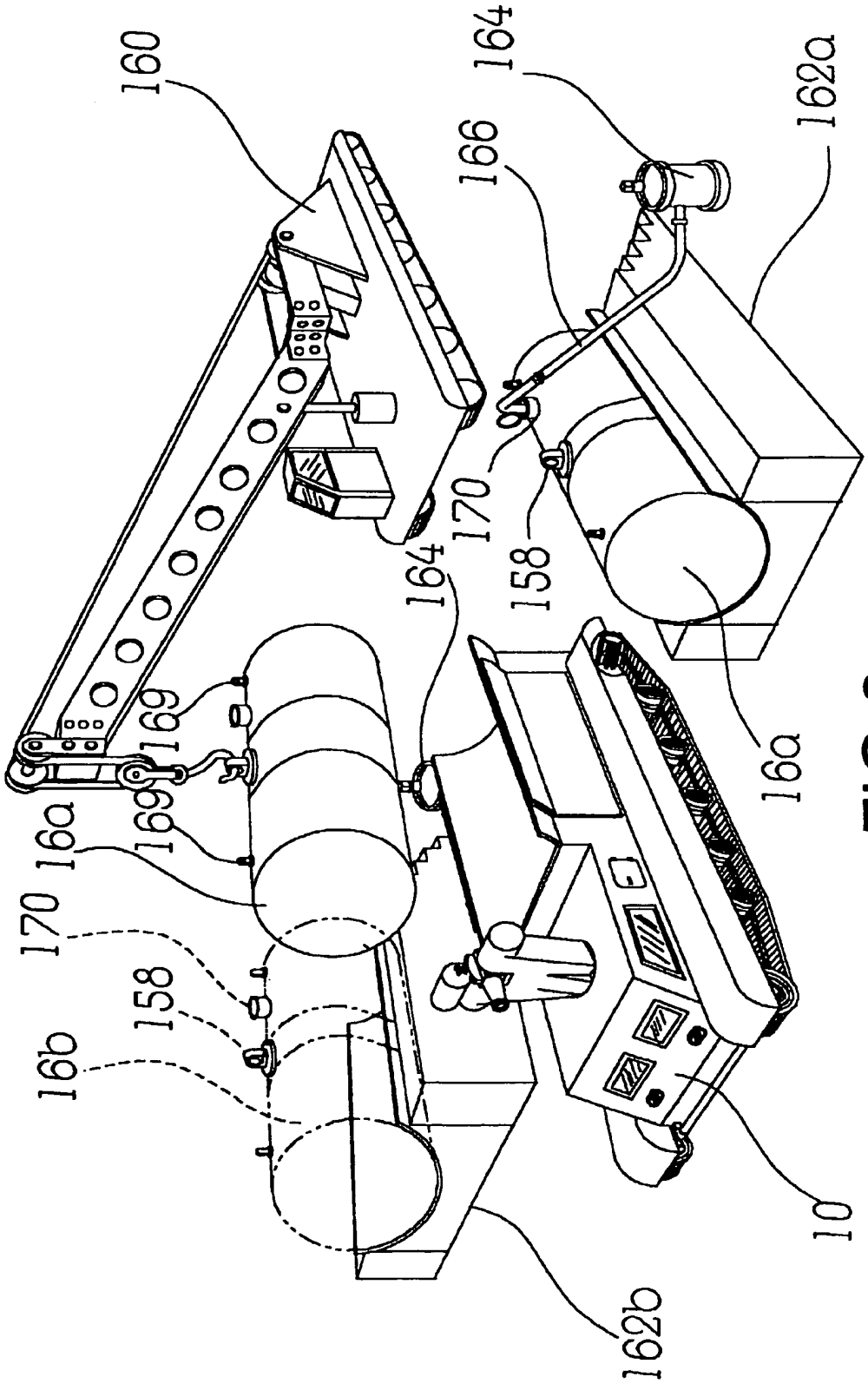
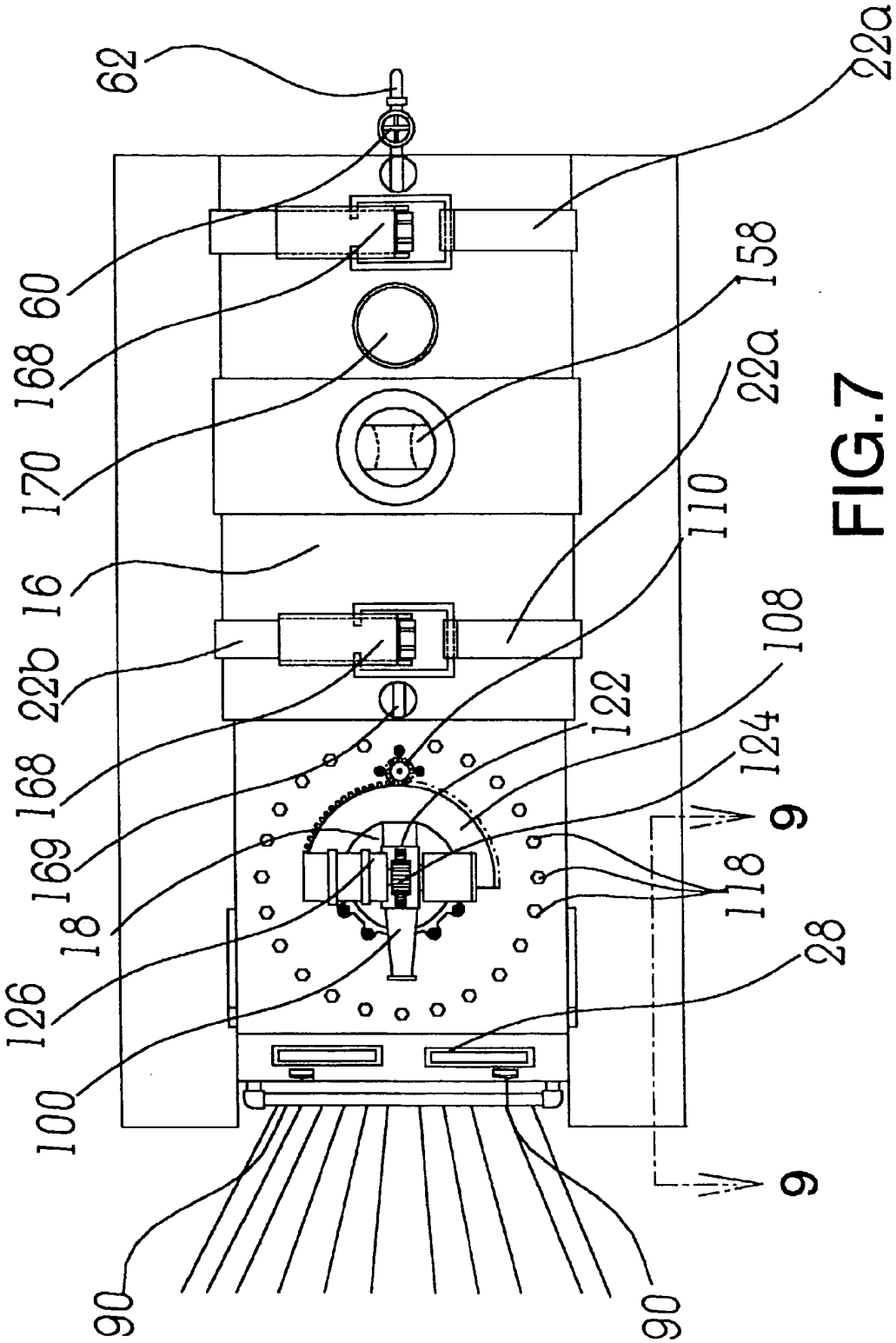


FIG.6


62
22a
60
168
158
170
22a
16
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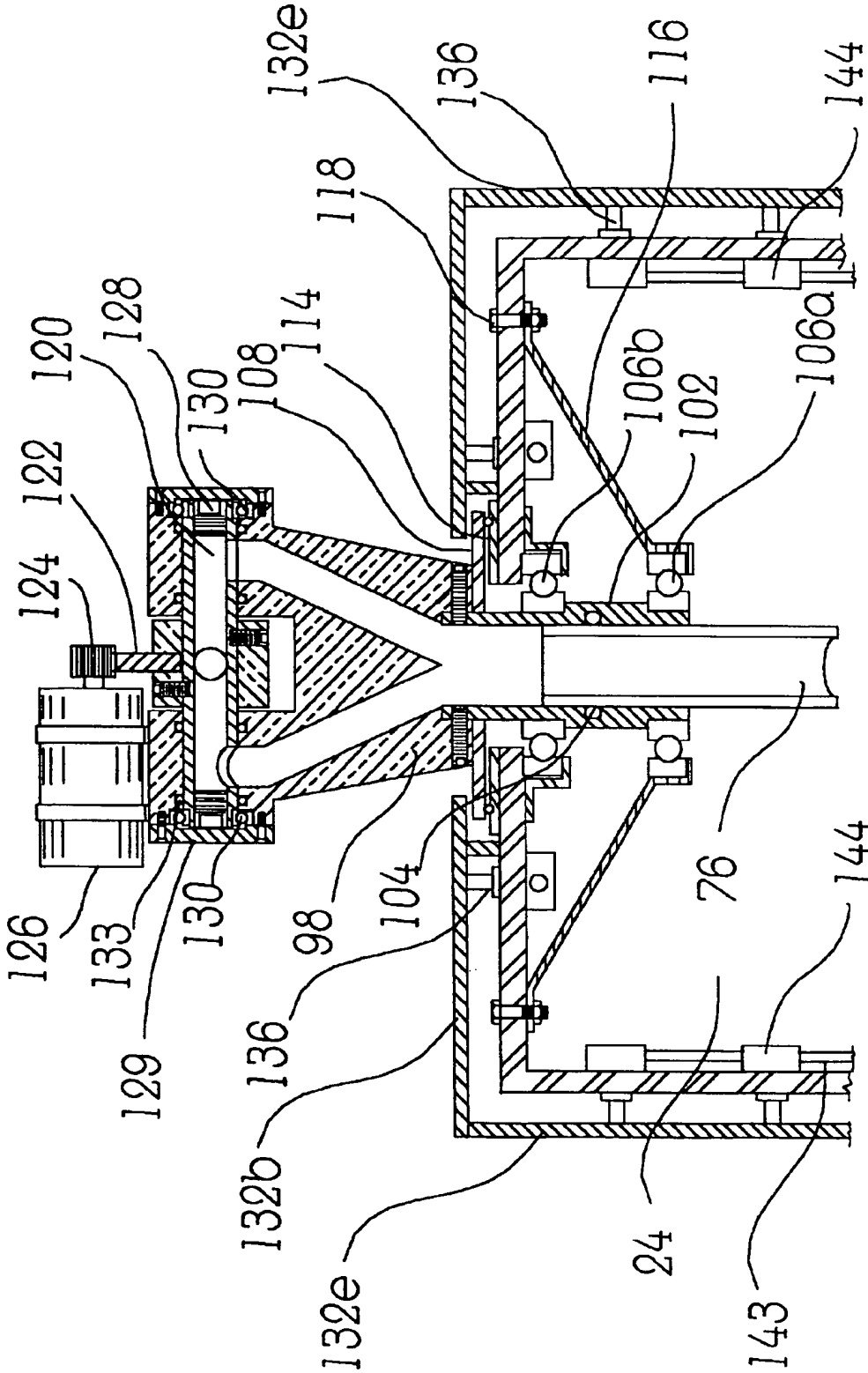
22b
108
168
122
124
169
9
18
118
126
28
100
9
90
90

FIG.7


132e
136
116
144
118
128
120
114
108
130
106b
102
106a
122
124
126
133
130
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104
76
144
129
136
132b
132e
24
143

FIG.8

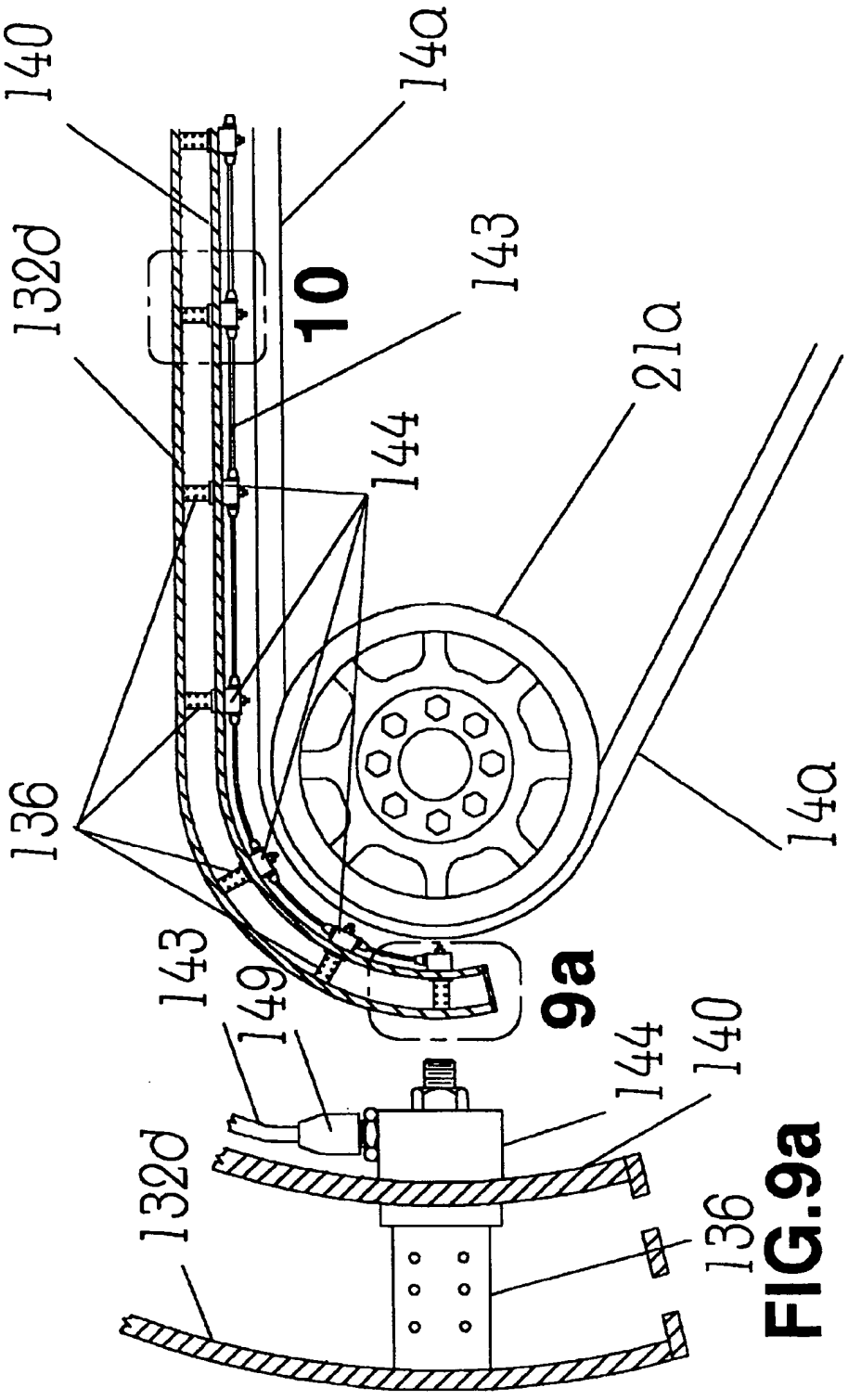

FIG.9

FIG.9a

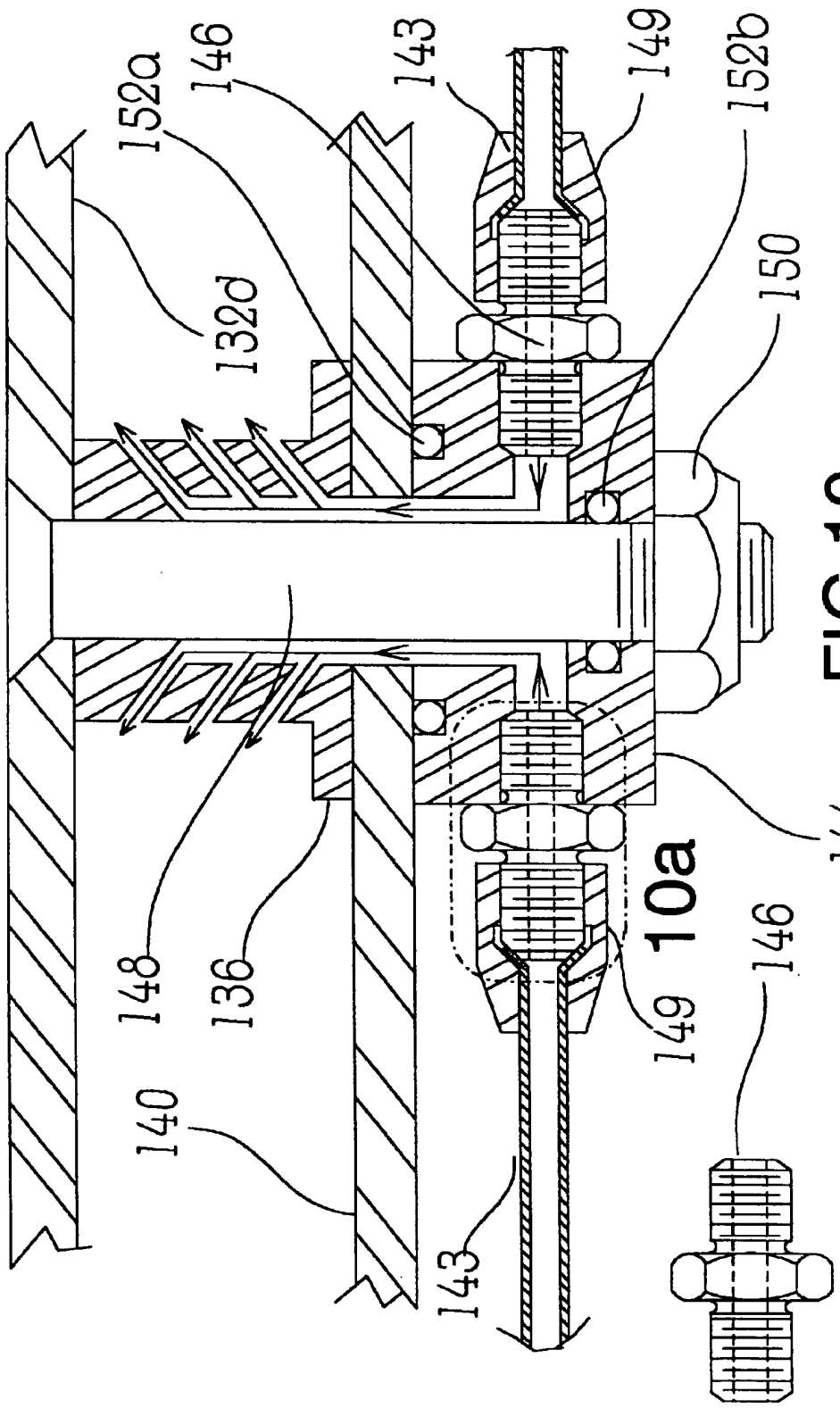

FIG.10

FIG.10a

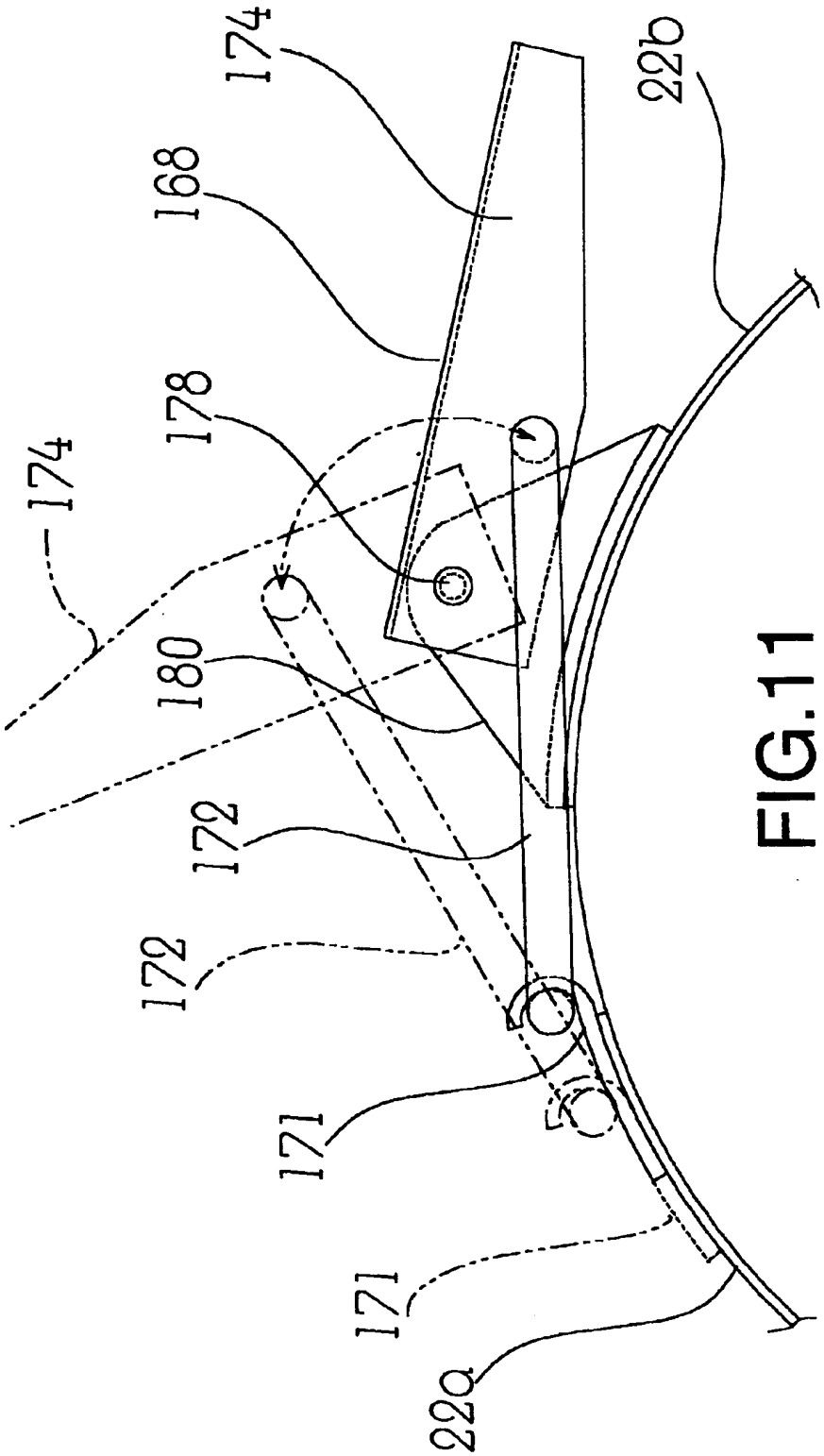

FIG.11

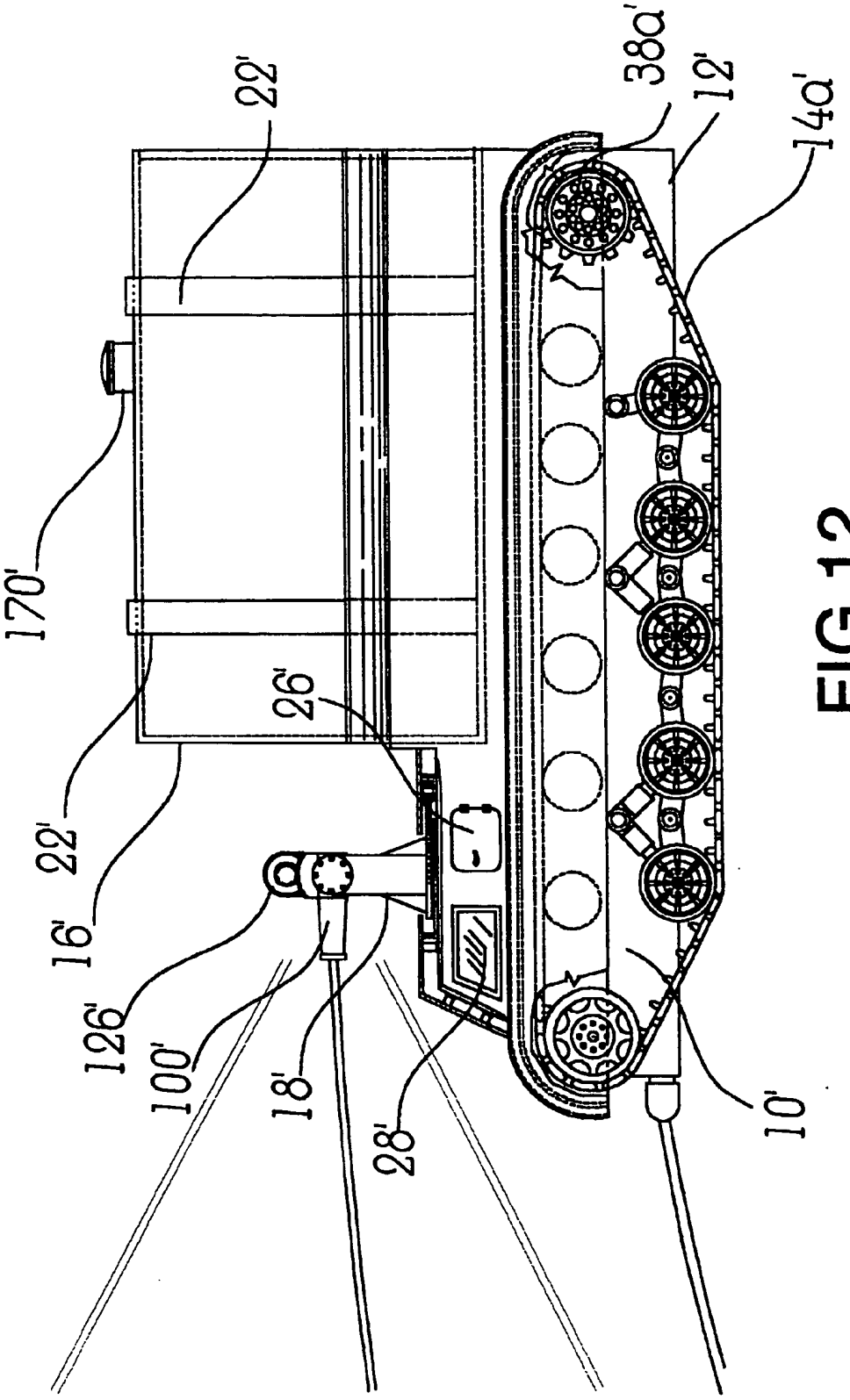

FIG.12

ROUGH TERRAIN, LARGE WATER VOLUME, TRACK DRIVEN FIREFIGHTING VEHICLE AND ITS METHOD OF OPERATION

FIELD OF THE INVENTION

The present invention relates to a vehicle to control and extinguish wind driven brush fires such as the fires experienced in California during periods of high winds, low humidity and high temperatures, known as "Santa Ana Conditions". More particularly, the invention relates to a vehicle with tracked running gear for all terrain capability, a large onboard water tank, which may be removable for quick turnaround at the refill site, a universal nozzle capable of delivering at least 200 gallons of water per minute 180 degrees in azimuth and 30 degrees up and down and heat shields cooled by a system of standoff sprinklers behind the shields. The vehicle may also be used to fight other fires at close range while protecting the operating crew.

DESCRIPTION OF THE PRIOR ART

Fighting wind driven brush fires in rugged terrain has been proven to be dangerous and difficult to accomplish. Fires of this type have devastated Southern California at least once a decade for many years causing huge losses to property owners and insurance companies as well as injuries and death. Present methods of fighting these fires have proven to be marginal at best, as year after year these fires burn from the San Fernando Valley to Malibu without containment. Present methods of fighting these fires include conventional fire engines with man held fire hoses, helicopters, aircraft and men with picks and shovels. All these methods have proven to be inadequate to prevent the huge losses that have ensued. The helicopter has been marginally effective because it carries only 300 gallons of water which spreads over a considerable area and partially evaporates before reaching the source of the flames. Aircraft tankers carry up to a thousand gallons of water but suffer from the same limitations as the helicopters namely, evaporation and intermittent application of water. Also, both airborne vehicles are limited to daytime operation since flying at night is too dangerous. Fire engines are not all terrain vehicles and must operate on roads and close to fire hydrants. Men with pick and shovels cannot operate close to the fire source safely and can be in danger of death or serious injury in case of sudden wind direction change. Patents have been granted for vehicles that can be operated by remote control allowing the fire fighters to remain at considerable distance from the flames and still apply water directly on the source of the flames. Examples of these patents are U.S. Pat. No. 2,360,397 issued to E. E. Carpenter, U.S. Pat. No. 3,724,554 issued to P. D. Rupert et al., and U.S. Pat. No. 3,762,478 issued to P. F. Cummins. These vehicles may only be effective under ideal conditions, namely having a source of water nearby and long hoses strong enough to feed the vehicle as it attacks the fire in rugged terrain. A fast moving wind driven brush fire would be difficult to contain with these devices due to their limited maneuverability. All of these devices require a source of water connected to the remote control vehicle by long hoses which would be difficult to control in the brush covered less than ideal terrain of Southern California. U.S. Pat. No. 4,875,526 issued to Latino et al. addresses many of the problems of prior fire fighting apparatuses. However, coordinating all three sections of this vehicle, using two operators in separate sections of the vehicle may cause problems in difficult terrain.

Therefore there is still a need for a self contained vehicle that can operate in rugged terrain, applying water directly to the source of the fire, for extended periods of time, with protection for the crew and heat shielded to protect for the vehicle. The vehicle of the present invention will satisfy the above conditions and operate on a 24 hour schedule

SUMMARY OF THE INVENTION

Fulfilling the need for an all terrain fire fighting vehicle that can safely attack the source of a wild fire for an extended period and operate day and night is the purpose of this invention. This purpose is obtained by using a tracked running gear similar to a battle tank carrying a large water tank. For example, a tank of approximately 6,000 gallon capacity, feeding a universal nozzle capable of delivering at least 200 gallons per minute to the base of the flames. Other features of this vehicle are heat shields cooled by a system of standoff sprinklers located between the heat shields and the structure and a forward spraying sprinkler to control flareups.

More specifically the present invention relates to a fire fighting vehicle. The vehicle has a frame and a drive system for the vehicle supported on the frame. Tractor treads are supported from the frame by support means including rotatable drive and idler shafts, rotatable drive shafts being driven by the drive system engine through the transmission allowing separate driving shafts rotatably supported on the frame. An operating compartment for at least one occupant is supported on and constitutes part of the frame. Power control means within the compartment is connected to the drive system and controls power delivered as well as the speed and direction of movement of the respective treads. A water storage tank is supported on the frame. A high volume water nozzle is mounted on the frame such that it permits movement of the nozzle relative to the frame sufficient to cover a fire by movement over a predetermined field. A conduit between the water storage tank and the water nozzle includes a control valve in the conduit having control in the operating compartment.

Advantageously, fixed spray means is also supported on the frame in position to direct a distributed spray in front of the vehicle. A spray connection conduit between the water storage tank and the fixed spray includes at least one control valve in the spray connection conduit.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a left hand elevation view of the firefighting vehicle, illustrating the all terrain, tracked running gear, the forward spraying sprinkler, the universal nozzle and the removable tank.

FIG. **2** is a cross section taken along line **2**—**2** of FIG. **4** showing the internal arrangement of the components that operate the various systems that drive the vehicle and supply the pressure to the three main firefighting systems namely the universal nozzle, the forward spraying system and the heat shield cooling system.

FIG. **3** is a plan cross section taken line **3**—**3** of FIG. **1** further defining the vehicle's internal components.

FIG. **4** is a front elevation view of the vehicle, with the horizontal heat shields omitted for clarity, showing the universal nozzle with its vertical drive motor and its ball bearing platform which assists in its azimuth capability.

FIG. **5** is an elevational view looking forward from the rear of the vehicle showing the overcenter clamp and the straps that hold the water tank in place and the removable

hose and shutoff valve that connects the removable tank to the onboard tank.

FIG. **6** is an elevated perspective view of the support equipment required to accomplish removing an empty tank from the vehicle and replacing it with a full tank.

FIG. **7** is a plan view of the vehicle from above showing the arrangement of the exterior components with heat shields over the operators compartment removed to clarify the drive system of the universal nozzle.

FIG. **8** is an enlarged section view taken along line **8**—**8** in FIG. **1** of the upper portion of the operating compartment defining the details of the universal nozzle and the heat shields.

FIG. **9** is an enlarged partial sectional view taken along line **9**—**9** FIG. **7** showing the standoff sprinkling system in the fender of the vehicle.

FIG. **9***a* is a further enlargement of a region labeled FIG. **9***a* showing a manifold and standoff sprinkler within the dashed line enclosure of FIG. **9**.

FIG. **10** is an even greater enlargement in cross section of the standoff sprinkler and its manifold in the dashed line enclosure of FIG. **9** labeled FIG. **10**.

FIG. **10***a* is a view solely of AN 815 nipple to clarify the part connecting the conduit to the manifold. The AN 815 nipple is one piece and is within the dashed line enclosure in FIG. **10**.

FIG. **11** is an enlarged side elevation view of the over-center clamp.

FIG. **12** is a simplified view of the fire fighting vehicle with an integral tank that must be filled while the vehicle is off station.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** to **7** of the drawings, the preferred embodiment of the fire fighting vehicle generally designated **10**, includes frame **12**, track type running gear **14** a removable tank **16** supported on the frame, universal nozzle assembly **18** supported on the frame. The universal nozzle is capable of delivering at least 200 gallons per min. of water 100 feet ahead of the vehicle and movable relative to the frame 180 degrees in azimuth, and 30 degrees in elevation (up and down). A forward spraying sprinkler system **20** is used to extinguish smoldering embers left in the wake of main wild fires as they are brought under control. Removable straps **22** hold the tank in place in a cradle on the frame **12**, but when released permit lifting the tank from and lowering the tank **16** into the refilling cradles by means of lifting fitting **158**, as shown in FIG. **6**.

FIG. **3** as well as the other overall drawings also show that the frame provides an operating compartment **24** for human operator(s) of the vehicle. An entry door **26** provides access by the operators to the operating compartment. Alternatively, robots within the compartment can be used to remotely control the vehicle to avoid exposure of the operators to the fire. If such an option were used operators could rely on sensors on the vehicle. The windows can be eliminated if the sensors are placed on the outside of the frame to aid the operators in remote control.

As will be explained in greater detail below, the compartment is designed for two operators, one of whom drives the vehicle and the other controls the fire fighting equipment. In other embodiments, a single operator might perform both functions. Both need to see out of windows **28**. The track type running gear **14** will give this vehicle all terrain capability allowing it to attack the fire at its source and not be limited to roads. The vehicle will be able to operate at considerable distance from a water source and not be limited by the location of fire hydrants. This vehicle could be supported by tanker trucks located on the nearby roads or by water filling stations of the type similar to that shown in FIG. **6**. With a 6,000 gallon water tank **16** delivering 200 gallons per minute and supplying the forward spraying sprinkler and the heat shields **32***a*, **32***b*, **32***c*, **32***d* and **32***e* with water for its cooling system **69**, this fire fighting vehicle will be able to stay on station, fighting the fire at its source for approximately 25 to 27 minutes between refillings.

Fire fighting vehicle **10** has a frame **12** which has not been shown in detail but will, in many respects, resemble the frame used for military battle tanks. The frame must be rigid and strong enough to resist bending and twisting forces of the terrain on which it much be used and which will tend to loosen the parts and cause breakup of the structure. Thus the frame takes advantage of the structural design principles well known in rough terrain vehicles such as battle tanks but which need not be considered in detail here. Additionally, insulation (not shown here) should be applied to the inside surfaces of the control compartment. The frame must support the various parts of the system shown in FIGS. **2** and **3** including an engine **30** having a drive shaft **34** to a transmission **36** which, by separate controls, allows the individual output shafts **38***a* and **38***b* to operate at different speeds, if so desired. Sprockets **39***a* and **39***b* to drive the respective treads **14***a* and **14***b* may be adjusted to run at different speeds from one another and in fact run in opposite directions, if desired. Details of variable transmissions for each of the shafts **38***a* and **38***b* are not disclosed but various means are known in the art of driving battle tanks and tractors at different speeds and in fact in opposite directions. For example, it would be possible to have a pair of slide controls, one for each shaft, whose relative positions determine relative speeds of the shafts **38***a* and **38***b* to determine the sharpness of turns. An accelerator or throttle for controlling engine speed is also needed. Whatever controls are provided are in the operator compartment **24**. The driving operator sits in seat **42** and has only the driving console in front of him. The driver's console **40** has gages, switches and possibly a throttle, which may alternatively be located on the floor. In this case there is provided a steering wheel **44** which may translate, through a computer, the required relative speeds of shafts **38***a* and **38***b* and their driven treads **14***a* and **14***b* to produce turns as required. Such an arrangement translates more directly to driving a car and requires less training of the driver. A starter button or ignition key, like those commonly used on automobiles may also be included at console **40**. The batteries **46** needed to start vehicle and supply power for other purposes are in a utility compartment behind the wall **48** and beneath the tank supporting cradle. Thus, the utility compartment has a very low clearance below the tank but in case it must be accessed during use, and in any event for maintenance purposes, a door **52** is provided in panel **48**. Panel **48** should be an insulated fire wall and the door **52** should be likewise insulated and tightly sealed to the panel when closed.

Similarly, there is a console for the fire controller through which valves may be opened and closed to control the various water distribution systems. The fire controller sits at seat **56** and has at his right hand a joystick **58** which acts to control both the azimuth and elevation of the universal nozzle. Single controls to move a device like the main nozzle are available to simplify what would otherwise require separate controls for azimuth and elevation movements.

FIG. 2 and FIG. 3 show the utilities compartment **50** and show the internal arrangement of major components of vehicle within that compartment such as the engine **30** which ultimately delivers power to the transmission **36** for controlling the drive shafts **38***a* and **38***b* to respective tracks **14***a* and **14***b* and permitting maneuverability. The structure and nature of the treads **14***a* and **14***b* and their support structures and connection to the frame is illustrated schematically. It will be understood that structures used in military tanks or tractors may be employed. In addition to the drive sprockets **39***a* and **39***b* at the rear of the vehicle, and in the front idler sprockets **21***a* and **21***b* rotatably supported on shafts from the frame, at the front of the vehicle, broadly define the range of the track path. Other guide and path defining members are rotatably supported on the frame or supported on intermediate linkage, spring and shock absorbing structure, generally designated **43***a* and **43***b*, that allows the track members **14***a* and **14***b* to absorb shocks and conform to the terrain during its passage through the lower portion of the track path.

FIG.4 illustrates the front configuration of the vehicle. The front and side windows **28** provide visibility for the operators and by the use of double panes of quartz with an air space between the panes, insulate the operating compartment **24** from the extreme heat of the fire. Headlights **90** with quartz lenses are provided to assure visibility at night when helicopters and aircraft cannot be used to fight fires.

The main water tank **16** has a valve **60** connecting the tank through a pump **72** to the main nozzle assembly **18**. Pipe **62** is connected to the low point of the tank by connecting hose **64**, which in turn connects to the inlet **66** of holding tank **68**. Holding tank **68** is at the very bottom of the utilities compartment **50**. Tank **68** has an outlet manifold **70** which connects to various distribution systems. Manifold **70** connects tank **68** to main water pump **72** which in turn has a pipe connection outlet **74** running beneath the floor of the compartments to a stationary vertical standpipe **76** which as seen in FIG. **2** leads to the nozzle assembly **18**. A control valve **78** in the inlet to pump **72** may be opened to permit water to be pumped by pump **72** from tank **68**. A solenoid valve is preferably used and controlled by a switch at control panel **54**. Similarly, water is distributed to the stationary sprayer **20** through plumbing connection **75** back to pump **80**. The pump **80** connection from the manifold **70** is controlled by the solenoid valve **82**. A further pump **84** has a connection to a network of plumbing feeding heat shields cooling nozzles described below. Pump **84** is connected from manifold **70** through a solenoid valve **86**. Solenoid valves **78, 82** and **86** are controlled by switches at control panel **54**. While fighting fires, the human operators are kept cool by air conditioning units **88** which derive their operating power from the batteries **46** and the power supply including a generator driven by the motor **30** or other moving parts (not shown) deriving power therefrom.

The pump **72** feeds water from the auxiliary tank **68** to the universal nozzle assembly **18** through a series of pipes **74** and **76** to the distribution system shown in FIG. **8** which allows for the rotation of the universal nozzle assembly **18**.

FIGS. **1** and **2** show the nozzle assembly **18** in elevation and in section, respectively. FIG. **8** illustrates the universal nozzle assembly **18** by means of a cross section of the upper area of the operator compartment **24**, showing particularly relative rotatable parts and their drives as well as the flow channels to the nozzle **100**. Water from the main water system pump **72** is introduced into the universal nozzle assembly **18** through pipes **74** and **76** which are stationary and through a housing **98** rotatable about a vertical axis and extending through a hole in the roof of compartment **24**. Housing **98** has an axial cylindrical recess terminating in a shoulder at its upper end. Tubular bearing support **102** fits snugly within the recess and seats against the shoulder and is held in place by radially directed screws through the bearing support and the housing **98**. The inside cylindrical surface of tubular bearing support **102** fits snugly over vertical pipe **76** but permits relative rotation therebetween around a vertical axis. An O-ring **104** is received in an inward facing groove in the inside cylindrical surface of the bearing support **102** and seals against the outer surface of pipe **76** in order to prevent leakage into compartment **24**. The larger diameter center of tubular extension **102** terminates in shoulders which index the bearings **106***a* and **106***b* supported on the smaller diameter portion of extension **102**. The housing **98** is attached at a bottom flat surface to the drive shaft of azimuth drive system gear plate **108** which has gear teeth along its outer edge. Gear plate **108** is engaged by a pinion gear **110** axially mounted on the shaft of motor **112** (see FIG. **2**) to cause the universal nozzle assembly **18** to rotate about a vertical axis. The platform bearing **114** is provided by balls in a grooved race in a plate on top of the compartment **24** and a similar race in the gear plate **108**. This bearing, the thrust bearing **106***b* and the radial bearing **106***a* take the loads generated by the pressurized flow of water through the main water system as well as gravity. The bell housing **116** fixed to the frame at the ceiling of compartment **24** by the shear bolts **118** takes the rotary loads generated by the jet stream out to the frame through the shear bolts **118**. Water flows through the housing **98** dividing into two streams fed into each end of the cross tube **120**,converging at the middle and exiting therethrough the bore of the nozzle **100** are fixed together and are rotated up and down by an integral gear segment **122** driven by a pinion gear **124** on elevation drive motor **126**. Electric motor **126** is controlled by the fire controller by means of his hand control joystick **58**. Bearings **130** assist in the rotation and **0**-rings **132** seal the universal nozzle assembly **18** against leakage during relative rotation of the nozzle **100** and its unitary structure relative to the housing **98**.

FIG. **7** is a plan view of the exterior of the vehicle showing , in particular, the gearing of the azimuth drive system and the vertical drive system for the universal nozzle assembly. The heat shielding has been omitted in this area to reveal these details. The other views illustrate the position of the heat shields when functioning.

Heat shields are of importance to fire fighting vehicles of the type that is described. They help to cover areas which are directly exposed to the heat of the fire with the idea of keeping occupants of the operating compartment **24** as comfortable as possible under the circumstances. They also protect the upper part of the tractor treads covered by fenders securely fixed to the structure to allow their use as access platforms for people entering the compartment **24** or maintaining the vehicle. Not all views show heat shields because they may obstruct other structure that needs to be described. But FIGS. **1**, **2***a*, **9***a*, **10**, and **10***a* all have to do with the heat shields or the related structure. For example, a heat shield generally conforming to the shape of the operational compartment **24** is included. The front wall has heat shield **132***a*. Heat shield **132***b* conforms to the roof of compartment **24**. Sidewalls of the compartment are covered by heat shields **132***e*. Openings in the heat shields are provided for windows **28** and headlights **96** as seen in FIG. **4**. The double construction of the floor **134** seen in FIG. **2** provides a space accommodating the auxiliary water tank **68** and plumbing to and from the various pumps but also a heat shielding space.

The heat shields preferably are spaced from the structure which they cover and protect using standoff sprinkler **136** seen in FIG. **10**. The standoff sprinklers are designed to provide ducts and spray nozzles.

FIG. **9** shows heat shield **132***d* for the track fender **140** which cover the tops and extend around the ends of the track and are also brought part way down toward the ground. A lateral cover **141** may be detachable for access to the track support structures. Cooling water distribution systems generally designated **143** extends inside the compartment **24** and beneath the track fender **142**. FIG. **9** shows a typical arrangement of the standoff sprinklers **136**, their manifolds **144** and the piping system that feeds the standoff sprinklers as specifically applied to the fender heat shield.

The heat shield piping system is connected to pump **84** which is supplied water under pressure to feed the matrix of standoff sprinklers **136**. FIG. **9***a* is a detail of a sprinkler at one end of the system. FIG. **10** is a greatly enlarged axial section of the standoff sprinkler **136**, the manifold **144** and the piping **147**. The standard plumbing fittings (known as a nipple) **146** with their couplings **149** as shown in FIG. **10**. FIG. **10***a* shows a view of the standard nipple **146** as it is produced by the manufacturer. The flow of water is indicated in FIG. **10** by the arrows. The manifold **144** and the standoff sprinkler **136** are held in place by a standard stainless steel counter sunk bolt **148** and nut **150**. Sealing of the manifold **144** to the fender **140** and bolt **148** is accomplished by O-rings **152***a* and **15***b*.

The main water tank **16** is removable so that it can be replaced with a full tank without delaying the return of the fire fighting vehicle to the fire site. FIG. **6** is a somewhat schematic perspective view of a fire fighting vehicle with a removable tank at a refill and replace station and the equipment required. A crane **160**, capable of handling a load in excess of 30 tons will be required to support this operation. Preferably the crane is portable and hence movable to a fire location where needed. Two cradles **162** are located adjacent to water sources, shown as hydrants **164**. Fillings hoses **166** are required sufficiently long to reach the tank filling point **170**. Preferably a hydrant for each cradle is provided as shown. Otherwise, a long hose sufficiently to serve both cradles will be required.

The procedure of "refill and replace," is as follows: the vehicle **10** is positioned, as shown, between the two cradles **162***a* and **162***b*. The overcenter clamps **168** shown in FIG. **11** are released and straps **22***a* and **22***b* are removed. The valve **60** is shut off and the hose **64** is disconnected from the tank. The crane **160** then lifts the empty tank **16***a* from the bed of the vehicle and positions it in cradle **162***a*. Ropes (not shown) are fed through positioning fittings **169** at the top of each end of the tank to assist human handlers in the positioning operation. The refilling of the now empty tank **16***a* begins at once from the hydrant **64** through the fillhose **166** into the tank **16***a* by way of the filling port **170** so that tank **16***a* will be ready when the next fire fighting vehicle appears. The crane **160** then turns to pick up the full tank **16***b*, shown in phantom and deposits it on the vehicle, as shown. Straps **22***a* and **22***b* are reattached, the hose **64** is reconnected and the valve **60** is opened. The vehicle is then ready to return to the fire and resume its fire fighting task.

FIG. **11** is an enlarged detail view of an overcenter clamp **168** located at the ends of strap parts **22***a* and **22***b* to secure the removable tank **16** in place in the cradle on the vehicle. The hook **171** at the end of strap **22***a* is engaged by the loop **172** which is a part of the overcenter assembly attached to end of strap **22***b*. The ends of loop **172** hook into holes in the side walls of a channel shaped toggle lever **174**. The lever **174** is rotated about pin **178** which is part of base channel **180** attached to the end of strap **22***b*. In so moving hook **171** is pulled with its strap **22***a* toward strap **22***b* until the straps stretched and are pulled out so that they snugly engage the tank as the lever **174** moves overcenter of pin **178**. By this operation the tank **16** is secured in place. Overcenter clamps of this type are manufactured by several suppliers.

FIG. **12** is similar to FIG. **1** showing in elevation a similar fire fighting vehicle but having an integral tank **16'** permanently fixed in place to the frame with permanent straps **22'** securing the tank **16'** to the vehicle. This vehicle otherwise has all the features of the removable tank embodiment. Some of the corresponding parts have been identified with the same number indicator with the addition of a prime thereto. It would require much more time off station to refill the permanently attached 6,000 gallon tank. To effectively fight a large fire, at least two vehicles of this type would be required to keep at least one vehicle working on the fire while the other vehicle is being refilled. On the other hand, where the purpose is to fight limited fires, a single vehicle would save the cost of a second vehicle plus the additional man power to operate and maintain that vehicle.

The above described fire fighting vehicle and its two embodiments represent a novel and viable way to effectively fight brush fires in California and ground fires elsewhere. The structures described to a large extent are representative and intended to provide an embodiment of a concept which should be more effective in fighting such fires than current methods. The embodiment employing removable tanks has considerable advantage, particularly when the vehicles are made identical with one another and the tanks are universally exchangeable. In areas where there is a frequent danger, permanent stations could be established for filling and exchange of tanks with hydrants and cradles in place. In some places it might even be worthwhile to have a permanent crane, although in most cases having a portable crane would be more cost effective. In locations where having a permanent installation is not practical, the filling cradles could be set up at a point near a water supply. With today's technology, lightweight frame cradles can be quickly put in place and be highly effective. Where municipal water supplies are not available it would be possible to carry pumping equipment to pump water from a river or lake, or even from the ocean, although use of salt water would be a last resort because of its corrosive effect upon the plumbing and the other parts.

So much of the structures shown are state of the art that it has been deemed unnecessary to describe such structures in great detail and one skilled in the art would know how to find the components necessary to construct a fire fighting vehicle in accordance with the invention or could readily find and employ such information in the public domain. However, the general overall configuration of the fire fighting vehicle including location of mainstream delivery nozzle and the use of a sprinkler for controlling fire beneath or close to the vehicle and the general configuration of how the structures would be arranged, is believed to be novel. Multiple nozzles could be employed, of course, and employing them at a fixed elevation or even at a fixed azimuth, either based upon a wider spray pattern from the nozzle or from greater maneuverability of a particular vehicle or like, is believed to be obvious to one skilled in the art and such modifications are intended to be within the scope of the invention. Likewise, the variations permitting the changes in height of the horizontal axis of rotation of the nozzle itself, while not illustrated, are deemed to be within the scope of the invention and the knowledge of the man skilled in the art.

Shapes of tanks employed and method of attachment and detachment are not material to the invention. Variations which permit automatic connection to the water tank, when properly positioned on the vehicle, as well as other types of coupling, and various modes of delivery of water to the various points of use are deemed to be within the skill of

plumbers and other tradesmen. The use of fire fighting fluids other than water is considered an appropriate alternative within the scope of the invention. The use of a heat shield, or other cooling means for the operator compartment will find many variations. The specific embodiment shown is acknowledged to be one of many of the possible ways of performing a task considered to be within the scope of the invention. All structures and methods within the scope of the claims and reasonable equivalent hereof are deemed to be within the scope of the present invention.

I claim:

1. A fire fighting vehicle comprising,

a frame,

a drive system for the vehicle supported on the frame,

tractor treads supported from the frame by support means including rotatable drive and idler supports, the rotatable drive supports being driven by the drive system through separately driven drive shafts connected to the drive system,

power control means connected to and controlling power delivered to the drive system and the speed and direction of movement of the respective treads in response to vehicle positioning signals,

a water storage tank supported on the frame,

a high volume water nozzle, movable support means for the water nozzle on the frame, so as to permit redirection of the nozzle relative to the frame without changing vehicle position,

drive means connected between relatively movable-parts of the movable support means to reposition the nozzle by driving the parts relative to one another,

control means for powering and moving the drive means to enable desired nozzle positioning,

a water conduit between the water storage tank and the water nozzle, and

a remotely controlled valve in the water conduit responsive to command signals of need of water.

2. A fire fighting vehicle comprising,

a frame,

a drive system for the vehicle supported on the frame,

tractor treads supported from the frame by support means including rotatable drive and idler supports, the rotatable drive supports being driven by the drive system through separately driven drive shafts connected to the drive system,

an operating compartment for at least one occupant supported on the frame,

power control means within the operating compartment, connected to and controlling power delivered to the drive system and the speed and direction of movement of the respective treads,

a water storage tank supported on the frame,

a high volume water nozzle, movable support means for the water nozzle on the frame, so as to permit redirection of the nozzle relative to the frame without changing vehicle position,

drive means connected between relatively movable parts of the movable support means to reposition the nozzle by driving the parts relative to one another,

control means in the operating compartment for the drive means for repositioning the water nozzle by driving the movable connection,

a water conduit between the water storage tank and the water nozzle,

a valve in the water conduit, and

controls for opening and closing the valve in the water conduit in the operating compartment.

3. The fire fighting vehicle of claim 2 in which the frame is provided with a supporting cradle conforming to the storage tank and the tank is removable from the frame so that an empty tank may be removed and a full tank put in its place, and quick coupling connection is provided between the tank and the water conduit supported on the frame.

4. The fire fighting vehicle of claim 3 in which flexible connectors to secure a tank to the frame are quickly connectable to and releasable from around the tank.

5. The Fire fighting vehicle of claim 4 which the flexible connectors are straps fixed at one end to the frame of the vehicle brought together over the tank then connected together by cooperating members one of which includes a lever handle pivotally connected along a first axis to a support member at the end of one flexible strap and having one of the cooperating members engaging the other cooperating member on the other strap rotatably connected to the lever along a second axis parallel to the first axis but spaced from the first axis such that when the connection members are engaged, the lever can be moved about its first axis so that the second axis moves over center of the first axis in a toggle movement that will tighten the straps.

6. The fire fighting vehicle of claim 2 in which a fixed spray array is also supported on the frame to direct a distributed spray of water in front of the vehicle,

a water spray conduit connecting the spray array to the tank.

7. The fire fighting vehicle of claim 2 in which heat shields to cover surfaces of the operating compartment and other parts of the frame exposed to fire and heat are supported from the covered surfaces by stand offs and water is distributed to designated positions behind the heat shields by a water distribution systems and applied to the back of the heat shields by a system of manifolds and conduits connected to the water tank, with at least one control valve in a main conduit controlling flow to the system having controls in the operating compartment.

8. A fire fighting vehicle comprising,

a frame,

a drive system for the vehicle supported on the frame,

tractor treads supported from the frame by support means including rotatable drive and idler supports, the rotatable drive supports being driven by the drive system through separately driven drive shafts connected to the drive system,

an operating compartment for at least one occupant supported on the frame,

power control means within the operating compartment, connected to and controlling power delivered to the drive system and the speed and direction of movement of the respective treads,

a water storage tank supported on the frame,

a high volume water nozzle supported on the frame, movable support means for the water nozzle on the frame, so as to permit redirection of the nozzle relative to the frame without changing vehicle position,

drive means connected between relatively movable parts of the movable support means to reposition the nozzle by driving the parts relative to one another,

control means for powering and moving the drive means to enable desired nozzle positioning,

a water conduit between the water storage tank and the water nozzle,

a valve in the water conduit, and

controls for opening and closing the valve in the water conduit in the operating compartment,

controls for the nozzle positioning drive means in the operating compartment.

9. The fire fighting vehicle of claim **8** in which a fixed spray array is supported on the frame to direct a distributed spray in front of the vehicle,

spray connections conduit connects the water storage tank and the fixed spray array and includes at least one spray control valve, and

remote control for the spray control valve located in the operating compartment.

10. The fire fighting vehicle of claim **9** in which the high volume water nozzle is supported to rotate about a generally vertical axis relative the frame by a generally vertically oriented azimuth support structure, azimuth positioning structure to move the azimuth support structure and the supported nozzle around a vertical axis to selected positions,

an inter-connecting nozzle elevation positioning structure between the azimuth support and the supported nozzle to permit rotation of the nozzle about a generally horizontal axis relative to the azimuth support structure,

elevation positioning structure to move the elevation support structure and the supported nozzle relative to the azimuth support structure around a horizontal axis to a selected elevation position.

11. The fire fighting vehicle of claim **10** in which azimuth and elevation control structures, respectively, have hollow parts to provide part of the water conduit between the water tank and the nozzle and each has a rotating joint between its hollow parts with seals therebetween to permit flow of water through the conduit without leakage.

12. The fire fighting vehicle of claim **11** in which the relatively rotatable parts of the azimuth support structure and of the elevation support structure, respectively, are driven relative to one another by motor and gear linkages for rotatably repositioning those parts and control for the respective motors are positioned in the operating compartment close to the position of the person controlling.

13. The Fire fighting vehicle of claim **12** in which the tubular vertical water conduit snugly fits within a rotatably supported outer structure with sealing means between the relatively rotatable cylindrical surfaces thereof, and

the outer structure is supported on coaxial bearings, in turn supported on the frame and extending through an opening in the ceiling of the operating compartment.

14. The Fire fighting vehicle of claim **13** in which the outer structure carries a radially extending coaxial gear segment fixed to the outer member to rotate with it, which gear segment is engaged with and driven by a pinion gear driven by a drive motor supported on the frame having an axis of rotation parallel to that of the outer structure.

15. The Fire fighting vehicle of claim **14** in which the outer structure rotatable about a vertical axis in turn supports a block through which an extension of the conduit extends and which rotates with the outer member movable about the vertical axis and provides bearing support for a snugly received generally horizontally arranged tubular support member for the nozzle, the ends of the tubular conduit closed and at least one slot opening in the tubular member into which the conduit through the supporting outer structure connects in all operable rotational positions of the generally horizontal tubular member and seals are provided between the horizontal tube and the outer structure on both sides of each slot, and a nozzle is fixed to the horizontal tube so that its flow passage connects wit the interior conduit of the tube and its elevation may be changed by rotation of the tube, and drive structure is provided between the outer structure and the horizontal tube and nozzle in order to produce relative rotation about a horizontal axis.

16. The Fire fighting vehicle of claim **15** in which the horizontal tubular member supports the nozzle as the tubular member passes through a gap between separated upper ends of the outer structure and bearings are provided at each end of the horizontal tubular member to rotatably support the horizontal tubular member outside of the outside seals.

17. The Fire fighting vehicle of claim **13** in which the conduit in the outer structure is formed in a "Y"shape; the horizontal tubular member is provided with radial slot openings allowing continuance flow into it the horizontal tubular member in any operational rotational position from the each of the channels of the y, seals are provided in each of the Y-branches on each side of the conduit branches and the slot openings and the nozzle has its nozzle passage connected to the horizontal tubular member to deliver water to the nozzle from the conduit.

18. The fire fighting vehicle of claim **16** in which a gear segment is fixed to the horizontal tube to move with it and drive the tube to allowable operating positions by an engaging pinion gear on the horizontal shaft of a motor mounted on the supporting outer structure.

19. The fire fighting vehicle of claim **18** in which the stand offs for the heat shields are themselves conduits connected into the water distribution system and provided with spray openings directing water to the back of the heat shield they support.

20. The Fire fighting vehicle of claim **18** in which heat shields are provided at least on the front of the operating compartment as well as the top and sides thereof.

21. The Fire fighting vehicle of claim **19** in which at least one window for the operators is provided in the operating compartment through the compartment forward wall and the heat shield, each window having heat resistant light transmitting but heat retarding materials for each window.

22. A fire fighting vehicle comprising,

a frame,

a drive system for the vehicle supported on the frame,

tractor treads supported from the frame by support means including rotatable drive and idler supports, the rotatable drive supports being driven by the drive system through separately driven drive shafts connected to the drive system,

power control means connected to and controlling power delivered to the drive system and the speed and direction of movement of the respective treads in response to vehicle positioning signals,

a water storage tank supported on the frame,

a high volume water nozzle supported on the frame,

a water conduit between the water storage tank and the water nozzle, and

a remotely controlled valve in the water conduit between the water storage tank and the water nozzle responsive to command signals of need for water,

a fixed spray array also supported on the frame to direct a distributed spray of water in front of the vehicle,

a spray water conduit connecting the spray array to the tank, and

a remote controlled spray valve in the spray water conduit responsive to command signals of the need for spray water.

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